Claims

1. An antibody binding to 40-kDa OMP or a functional fragment thereof, which has activity of inhibiting the binding of hemin to 40-kDa OMP.

2. An antibody binding to 40-kDa OMP or a functional fragment thereof, which has (1) activity of inhibiting the coaggregation of *P. gingivalis* and (2) activity of promoting human neutrophilic phagocytosis.

3. An antibody binding to 40-kDa OMP or a functional fragment thereof, which has (1) activity of inhibiting the coaggregation of *P. gingivalis* and (2) activity of inhibiting the binding of hemin to 40-kDa OMP.

4. An antibody binding to 40-kDa OMP or a functional fragment thereof, which has (1) activity of promoting human neutrophilic phagocytosis and (2) activity of inhibiting the binding of hemin to 40-kDa OMP.

5. An antibody binding to 40-kDa OMP or a functional fragment thereof, which has (1) activity of inhibiting the coaggregation of *P. gingivalis*, (2) activity of promoting human neutrophilic phagocytosis, and (3) activity of inhibiting the binding of hemin to 40-kDa OMP.

6. The antibody or the functional fragment thereof according to any one of claims 2, 3, and 5, wherein the coaggregation of *P. gingivalis* is coaggregation of *P. gingivalis* and *Actinomyces viscosus*.

7. An antibody binding to 40-KDa OMP or a functional fragment thereof, which has activity of suppressing alveolar bone resorption.

8. The antibody or the functional fragment thereof according to any one of claims 1 to 7, wherein the antibody is a human antibody.

9. The antibody or the functional fragment thereof according to any one of claims 1 to 8, which is produced by a mouse-mouse hybridoma.

10. The antibody or the functional fragment thereof according to any one of claims 1 to 9, wherein the antibody is a monoclonal antibody.

11. The antibody or the functional fragment thereof according to any one of claims 1 to 10, which covalently or non-covalently binds to a therapeutic

agent.

12. The antibody or the functional fragment thereof according to claim 11, wherein the therapeutic agent is selected from antibiotics or antibacterial agents.

13. The antibody or the functional fragment thereof according to claim 12, wherein the antibiotic or the antibacterial agent is tetracycline or minocycline.

14. The antibody or the functional fragment thereof according to any one of claims 1 to 13, wherein the antibody class is IgG.

15. The antibody or the functional fragment thereof according to claim 14, wherein IgG is IgG1.

16. The antibody or the functional fragment thereof according to any one of claims 1 to 13, wherein the antibody class is IgA.

17. The antibody or the functional fragment thereof according to any one of claims 1 to 16, wherein the amino acid sequence of a heavy chain constant region is altered.

18. An antibody binding to 40-kDa OMP or a functional fragment thereof, which is produced by a hybridoma h13-17 (accession No. FERM BP-8325).

19. An antibody binding to 40-kDa OMP or a functional fragment thereof, which comprises variable regions of an antibody that is produced by a hybridoma h13-17 (accession No. FERM BP-8325).

20. The antibody or the functional fragment thereof according to claim 18 or 19, which covalently or non-covalently binds to a therapeutic agent.

21. The antibody or the functional fragment thereof according to claim 20, wherein the therapeutic agent is selected from antibiotics or antibacterial agents.

22. The antibody or the functional fragment thereof according to claim 21, wherein the antibiotic or the antibacterial agent is tetracycline or minocycline.

23. The antibody or the functional fragment thereof according to any one of claims 18 to 22, wherein the antibody class is IgG.

24. The antibody or the functional fragment thereof according to claim 23, wherein IgG is IgG1.

25. The antibody or the functional fragment thereof according to any one of claims 18 to 22, wherein the antibody class is IgA.

26. The antibody or the functional fragment thereof according to any one of claims 18 to 25, wherein the amino acid sequence of a heavy chain constant region is altered.

27. A hybridoma h13-17 (accession No. FERM BP-8325).

28. An antibody binding to 40-kDa OMP or a functional fragment thereof, which is produced by a hybridoma 5-89-2 (accession No. FERM BP-8323).

29. An antibody binding to 40-kDa OMP or a functional fragment thereof, which comprises variable regions of an antibody that is produced by a hybridoma 5-89-2 (accession No. FERM BP-8323).

30. The antibody or the functional fragment thereof according to claim 28 or 29, which covalently or non-covalently binds to a therapeutic agent.

31. The antibody or the functional fragment thereof according to claim 30, wherein the therapeutic agent is selected from antibiotics or antibacterial agents.

32. The antibody or the functional fragment thereof according to claim 31, wherein the antibiotic or the antibacterial agent is tetracycline or minocycline.

33. The antibody or the functional fragment thereof according to any one of claims 28 to 32, wherein the antibody class is IgG.

34. The antibody or the functional fragment thereof according to claim 33, wherein IgG is IgG1.

35. The antibody or the functional fragment thereof according to any one of claims 28 to 32, wherein the antibody class is IgA.

36. The antibody or the functional fragment thereof according to any one of claims 28 to 35, wherein the amino acid sequence of a heavy chain constant region is altered.

37. A hybridoma 5-89-2 (accession No. FERM BP-8323).

38. An antibody binding to 40-kDa OMP or a functional fragment thereof, which is produced by a hybridoma a44-1 (accession No. FERM BP-8324).

39. An antibody binding to 40-kDa OMP or a functional fragment thereof, which comprises variable regions of an antibody that is produced by a hybridoma a44-1 (accession No. FERM BP-8324);

40. The antibody or the functional fragment thereof according to claim 40 or 41, which covalently or non-covalently binds to a therapeutic agent.

41. The antibody or the functional fragment thereof according to claim 40, wherein the therapeutic agent is antibiotics or antibacterial agents.

42. The antibody or the functional fragment thereof according to claim 41, wherein the antibiotic or the antibacterial agent is tetracycline or minocycline.

43. The antibody or the functional fragment thereof according to any one of claims 38 to 42, wherein the antibody class is IgG.

44. The antibody or the functional fragment thereof according to claim 43, wherein IgG is IgG1.

45. The antibody or the functional fragment thereof according to any one of claims 38 to 42, wherein the antibody class is IgA.

46. The antibody or the functional fragment thereof according to any one of claims 38 to 45, wherein the amino acid sequence of a heavy chain constant region is altered.

47. A hybridoma a44-1 (accession No. FERM BP-8324).

48. A nucleic acid, which is possessed by a hybridoma selected from the group consisting of a hybridoma h13-17 (accession No. FERM BP-8325), a hybridoma 5-89-2 (accession No. FERM BP-8323), and a hybridoma a44-1

(accession No. FERM BP-8324) and encodes an antibody containing a variable region of an antibody produced by the hybridoma or a functional fragment of the said antibody.

49. A protein encoded by the nucleic acid according to claim 48, which is an antibody or a functional fragment thereof.

50. An expression vector, which has the nucleic acid according to claim 48.

51. A host, which has the expression vector according to claim 50.

52. The host according to claim 51, which is selected from the group consisting of *Escherichia coli*, yeast cells, insect cells, mammalian cells, plant cells, and mammals.

53. A method for producing an antibody binding to 40-kDa OMP, which comprises isolating a gene that encodes an antibody binding to 40-kDa OMP from a hybridoma selected from the group consisting of a hybridoma h13-17 (accession No. FERM BP-8325), a hybridoma 5-89-2 (accession No. FERM BP-8323), and a hybridoma a44-1 (accession No. FERM BP-8324), constructing an expression vector comprising the gene, introducing the expression vector into a host to cause expression of the antibody, and collecting the antibody from the obtained host, the culture supernatant of the host, or secretion from the host.

54 An agent for suppressing alveolar bone resorption, which contains an antibody binding to 40-KDa OMP or a functional fragment thereof as an active ingredient.

55. An agent for preventing, diagnosing, or treating periodontal diseases, which contains an antibody binding to 40-kDa OMP or a functional fragment thereof as an active ingredient.

56. Use of an antibody binding to 40-KDa OMP or a functional fragment thereof for production of an agent for suppressing alveolar bone resorption.

57. A method for suppressing alveolar bone resorption, which comprises preparing an antibody binding to 40-KDa OMP or a functional fragment

thereof and administering the antibody or the fragment to an animal.

58. Use of an antibody binding to 40-KDa OMP or a functional fragment thereof for production of an agent for preventing, diagnosing, or treating periodontal diseases.

59. A method for diagnosing, preventing, or treating periodontal diseases, which comprises preparing an antibody binding to 40-KDa OMP or a functional fragment thereof and administering the antibody or the fragment to an animal.

60. An agent for preventing, diagnosing, or treating periodontal diseases, which contains the antibody or the functional fragment thereof according to any one of claims 1 to 26, 28 to 36, 38 to 46, and 49 as an active ingredient.

61. An agent for suppressing alveolar bone resorption, which contains the antibody or the functional fragment thereof according to any one of claims 1 to 26, 28 to 36, 38 to 46, and 49 as an active ingredient.

62. Use of the antibody or the functional fragment thereof according to any one of claims 1 to 26, 28 to 36, 38 to 46, and 49 for production of an agent for preventing, diagnosing, or treating periodontal diseases;

63. Use of the antibody or the functional fragment thereof according to any one of claims 1 to 26, 28 to 36, 38 to 46, and 49 for production of an agent for suppressing alveolar bone resorption.

64. A method for diagnosing, preventing, or treating periodontal diseases, which comprises preparing the antibody or the functional fragment thereof according to any one of claims 1 to 26, 28 to 36, 38 to 46, and 49 and administering the antibody or the fragment to an animal.

65. A method for suppressing alveolar bone resorption, which comprises preparing the antibody or the functional fragment thereof according to any one of claims 1 to 26, 28 to 36, 38 to 46, and 49 and administering the antibody or the fragment to an animal.